incorporating into the model some of the costs that would make actual full replacement more costly than incremental replacement.

A. VERIZON VA'S COST STUDY IS FORWARD-LOOKING.

Q. Please explain how Verizon VA's model is forward-looking.

A. Verizon VA's model of recurring costs is based on the technology mix that Verizon VA expects will be deployed in its network over a three-year planning period in accordance with its forward-looking engineering guidelines. That model measures the costs that will be incurred at the *end* of the deployment period, not the costs that exist today. Moreover, Verizon VA's study does not estimate the costs that will *in fact* accrue at the end of the planning period, but instead provides a measure of the costs that *would hypothetically* exist if the best-available technology mix had been fully implemented network-wide.

Loops and cable plant: For example, consider the loop plant assumptions in Verizon VA's model. The existing loop plant in Verizon VA's Virginia network consists overwhelmingly of copper. The forward-looking plant configuration, however, is premised on Verizon VA's analysis that a mix of 17.7 % copper and 82.3 % fiber would be the most cost-efficient one for loops based on today's best technology.[5] It is estimated that at the end of the three-year study period, the actual percentages of copper and fiber cable plant will be approximately 63% and 37%, respectively. Yet Verizon VA's cost model does not base its estimates on those expected, actual proportions. Instead, the model assumes that the mix of copper and fiber throughout the *entire* network will be that which Verizon VA has estimated would yield the most cost-efficient mix: 17.7% copper

[5] *See* Verizon VA Cost Panel Testimony § V.C.

and 82.3% fiber. This measure is quite stringent: it does not account for all current network costs, or even all the costs that Verizon VA actually expects to incur at the end of the planning period. Instead, it measures the costs that Verizon VA would incur if this mix were fully implemented through the entire network.

Verizon VA's model thus goes beyond incremental replacement and upgrades to the existing network. Instead, it assumes full deployment of the best available loop technology over the planning cycle. The model thus likely generates forward-looking operating and maintenance costs that, when adjusted for changes in quality and quantity of services, are lower than those that will actually exist. Importantly, Verizon VA's model does not incorporate costs that might offset the lower O&M costs that result from full replacement, such as the high depreciation rates of full replacement or the costly risk factor that such wholesale replacement might turn out to be unwise in light of changing technology and market demand. Verizon VA's cost estimates are thus likely to be lower than the true network costs will be, to the benefit of competitors who pay UNE prices based on those costs.

Verizon VA has conducted a sensitivity analysis that highlights the way that its model might understate costs. The cost for a two-wire analog loop that results from Verizon VA's assumption of 17.7% copper and 82.3% fiber is $25.12 per month. But at the *actual* percentages of fiber and copper predicted to be in place at the end of the planning period (about 63% copper and the balance fiber) loop costs would be $28.76 per month. The costs that the model would yield if it were based on the loop technology that Verizon VA in fact expects to have in place in three years are therefore about 14 percent higher than the costs the model predicts under its full replacement assumption. Economic theory, however, says that resource allocations should be based on the higher true costs.

Switching: Verizon VA's cost model for switching is similarly forward-looking. Verizon VA has already heavily deployed advanced digital switches throughout its network. For the most part, Verizon VA currently deploys a mix of digital switching technologies, comprised of 5ESS, DMS-100, and EWSD platforms. I understand from the Verizon VA Cost Panel testimony that the inputs to the company's switching model include the technological adjustments necessary to evolve those switches on a forward-looking basis.[6] These adjustments are designed to arrive at the mix of switching technologies Verizon VA expects to need in the future, such as the latest available processors and line-side peripherals.

For example, the peripheral technology inputs into the model include a forward-looking mix of GR-303 and TR-008 digital interfaces. Verizon VA's switching model thus does not use the mix of switches currently deployed in the network. It instead looks ahead and measures costs based on the mix of switching equipment it expects to deploy in the future. And, as in the cable plant calculations, Verizon VA assumes that the forward-looking mix of switching facilities will be deployed throughout the network at the end of the planning period. For example, the company's switching model includes 10% GR-303 digital interfaces in the network as a whole because that is a very aggressive engineering assumption about the replacement rate of deployment over the planning period. Verizon VA may never actually reach that level of GR-303 deployment

[6] *See id.* § VI.

network-wide, however, and certainly will not by the end of the three-year planning period.

Verizon VA's switching cost model also assumes an appropriate price discount from vendors for the switching technology to be purchased going forward. Because Verizon VA has mostly deployed digital switching in its network, it will not receive greater price discounts in the future than it currently receives for *incremental* replacement of its switching plant. For that reason, it would be inappropriate to assume a greater discount — say the discount Verizon VA might receive for large-scale replacement of current switches — going forward. Verizon VA's forward-looking plans for switching do not include wholesale replacement. Indeed, such would make no economic sense given the company's network-wide deployment of current digital technology.

In sum, Verizon VA's engineering guidelines call for a mix of technologies reflecting the most efficient configuration moving forward based on the network currently in place. As I have already mentioned, even long-run cost studies begin with the existing network. This is particularly appropriate where the firm has had incentive to make efficient investment decisions in developing its current network. I note in this regard that Verizon VA has been under price cap regulation in Virginia since January of 1995, giving it strong incentives to invest optimally and to adopt the most efficient engineering practices going forward.

Q. In the first part of your testimony you said that an efficient firm generally replaces its network incrementally over time. Does the fact that Verizon VA's cost model assumes complete deployment of new network technology by the end of the planning period mean that it is violating that principle and thus generating inefficient, higher costs?

A. No. Verizon VA's model does not incorporate the potential inefficiencies of full replacement. Assuming that current plant will be replaced completely would likely reduce some of the costs estimated by the model. For example, operating and maintenance costs of an element are presumably lower, on an output-adjusted basis, with the more advanced new technology. In the real world, however, those cost savings might be offset by unexpectedly weak demand for the new network elements, by technological change that requires the new plant itself to be replaced sooner than expected, or when the purchase price of the new equipment is factored in to the replacement analysis. But Verizon VA, while assuming for some purposes that it has completely deployed the best available technology, is not using a model that incorporates all the costs of fully replacing the existing network. In particular, Verizon VA's depreciation allowances, costs of capital, and risk factors are correctly forward-looking and are likely lower than those that would be necessary to model the true costs of total network replacement.

Q. How, specifically, does Verizon VA's model avoid the inefficiencies of a full replacement-cost model while at the same time assuming today's best available technology is fully deployed?

A. Recall from the discussion in the first part of this testimony that several factors are likely to make full network replacement in the face of technological change more costly than incremental replacement of facilities. In particular, wasted value of existing plant, higher risk factors for unanticipated demand and technology conditions, and faster depreciation schedules would all be likely to drive up the costs of full replacement relative to those of incremental replacement. Verizon VA's model does not, however, incorporate those higher cost factors.

Consider, first, Verizon VA's capital cost inputs. The costs of capital in Verizon VA's model are estimated based on those incurred by competitive firms operating under conditions of risk and uncertainty similar to those that Verizon VA faces in providing UNEs. Such competitive firms have strong market incentives to keep capital costs down by avoiding inefficiently fast replacement of network facilities. Capital costs rise with risk and with purchases of new equipment, and a firm facing competition could not sustain inefficient levels of either. Accordingly, even though Verizon VA's cost study assumes that the most efficient available technology has been deployed network-wide, the study does not assume the inefficient risks and capital expenditures that would, in the real world, usually drive the long-run costs of such total replacement above those of incremental replacement.

The same argument applies to Verizon VA's depreciation analysis. The company's model does not assume that a network element will be replaced each time there is a technological improvement in the element. Instead, Verizon VA's cost model bases depreciation on the full period over which a network element is expected to produce economic benefits. By assuming that equipment will be used for its full economic life — that is, as long as the NPV of its expected costs are lower than the NPV of the costs of new equipment — Verizon VA's cost study avoids the economic waste or high depreciation allowances of a full replacement model.

In sum, then, Verizon VA assumes full deployment of currently available, efficient network technology, but in a way that captures the efficiencies without factoring in some likely costs of wholesale network replacement. As such, the model likely understates the forward-looking costs Verizon VA will incur to operate its network. In this regard, Verizon VA's model, partly for pragmatic reasons discussed by Dr. Gordon and perhaps also in the interests of ensuring compliance with the Commission's TELRIC rules, deviates somewhat from the efficient, incremental replacement model counseled by economic principles. That deviation is in a direction that favors competitive entrants into the local exchange market.

Q. Is Verizon VA's three-year planning period compatible with long-run, forward-looking cost estimation?

A. Yes. As I explained in part II.B, there is no magic number for the length of a long-run cost study that properly balances static efficiency concerns with uncertainty about the future. The more dynamic and uncertain the technological and market environment, the shorter the rational future forecast and investment plan is likely to be.

Telecommunications as a whole is a rapidly changing industry with a constant and unpredictable stream of infrastructure innovations and new service applications. Technological and demand conditions are highly uncertain and become entirely speculative even a few years into the future. Just a few years ago, the current importance of packet switching and data transport were unforeseen. Innovations like the GR-303 digital switching interface and IDLC were uncertain.

Commitment of investment capital far into the future would have greatly handicapped the ability of firms to respond to these unexpected changes and to re-orient their engineering plans in light of changed circumstances. It moreover would have proven to be a waste of resources. There is no reason to think the technological and market variability in telecommunications is diminishing, and, in light of developments like the above that illustrate the substantial risks and uncertainty of long time horizons, a three-year planning period appears quite reasonable. A longer planning period would quickly move engineering assumptions into a highly speculative mode: what will be the optimal switching technology several years from now? Is there any reason to be confident that GR-303, for example, will be the most advanced interface? If not, current investment plans that called for higher levels of deployment would possibly prove costly and unwise as new technology and demands on the network appear. This risk must be balanced against the theoretical long-run prescription of making all inputs variable. The FCC appears implicitly to have recognized this fact in emphasizing the role of the best "currently available" technology in its TELRIC regulations.

B. VERIZON VA'S CAPITAL COST AND DEPRECIATION ASSUMPTIONS FOR THE MODEL CORRESPOND WITH EFFICIENT, FORWARD-LOOKING OPERATION OF THE NETWORK.

Q. Please explain why Verizon VA's capital cost and depreciation assumptions for the model are based on correct economic principles.

A. The costs of operating the network on a forward-looking basis, with its mix of installed and new plant, include costs of capital and the costs of operating and maintaining the network elements. Capital costs of new plant can be thought of as the risk-adjusted return on investment that must be paid to induce investment in new facilities rather than in some alternative venture. The cost of capital for existing, unbundled network elements can similarly be thought of as the costs Verizon VA incurs by operating those network elements instead of selling them off and placing the funds in an alternative investment.

As explained in the testimony of Dr. James Vander Weide, a forward-looking model should estimate the cost of capital for Verizon VA's UNEs based on the capital costs incurred by other firms that operate in competitive markets under similar risks.[7] The premise of TELRIC is that the forward-looking costs of incumbent carriers should be treated as being constrained by competition in the local exchange market. Such competition is the basis for assuming forward-looking deployment of best-available technology in the cost models for network elements. Capital costs should similarly account for the investors' expectations of returns given the risks of investing in a company that operates in such a competitive environment. In the case of UNEs, the capital costs should account both for expected future levels of competition and for the

[7] *See* Testimony of Dr. James Vander Weide at 44-48.

risk of stranded costs from unanticipated changes in demand for UNEs. Dr. Vander Weide's capital cost estimates for Verizon VA's UNEs in Virginia are thus appropriately based on the market-based capital structure of a firm operating in competitive conditions, projected market interest rates, and the estimated risks posed by local exchange competition.

Depreciation rates should similarly reflect the effects of operating the network in a competitive environment. In particular, the greater the competitive pressure to deploy new technology and to recover only the economic value of those new facilities, the faster may be the depreciation rate necessary to recover the costs of new technology going forward. If the company anticipates having again to replace technology in the future, it will set depreciation allowances to fully recover the remaining economic value of installed technology before replacement becomes economically necessary. TELRIC requires firms to account for technological advances in estimating their costs and, correspondingly, to reduce the prices they charge for access to network elements as technology reduces the incremental costs of those elements. When technology changes, the firm must either replace installed plant that proves more costly than the new technology or else reduce the economic value of installed plant to reflect the existence of the new technology. As both Dr. Lacey and Mr. Sovereign explain in their testimony, to be forward-looking the depreciable life should be set as the time that the element is expected to continue to have economic value.[8] As Dr. Lacey discusses, GAAP depreciation lives are based on the expected future period during which an element will

[8] *See* Testimony of Dr. John Lacey at 4-5; Testimony of Allen Sovereign at 5-6.

produce economic benefits, and as such are forward-looking and in keeping with TELRIC.[9]

C. VERIZON VA'S NON-RECURRING COST MODEL IS FORWARD-LOOKING, EFFICIENT, AND COMPETITIVELY NON-DISCRIMINATORY.

Q. Does Verizon VA's model for recovering non-recurring costs comply with the economic principles you have discussed for forward-looking cost estimation?

A. Yes. I have reviewed the non-recurring cost section of the Cost Panel Testimony and based on that testimony I conclude that Verizon VA's non-recurring cost model is forward-looking and efficient. As the Cost Panel Testimony explains, Verizon VA calculates non-recurring costs by estimating how much time will be necessary at the end of the planning period to fulfill CLECs' non-recurring service requests (*e.g.,* provisioning a two-wire analog loop), multiplying that time by the predicted, levelized labor rate, and then adding a markup for common costs and other expenditures associated with these activities.[10] The time estimates used in the analysis are forward-looking. Verizon VA first determines the time currently necessary to perform a particular non-recurring service. It then determines the current likelihood that the activities giving rise to such services will occur. Together, these produce an estimate of the labor time Verizon VA can expect to devote to a given non-recurring task today. Verizon VA then has these estimates reviewed to determine whether demand and technology changes can be expected either to reduce the occurrence of a particular non-recurring activity or to

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9 *See* Testimony of Dr. John Lacey at 4-7.

10 *See* Verizon VA Cost Panel Testimony § XII.

reduce the time needed to perform such activities in the future. If either is the case, Verizon VA makes a corresponding reduction in its model.[11]

Accordingly, Verizon VA is considering non-recurring costs in a forward-looking manner. The model explicitly takes into account new technology to be deployed during the planning period, how that technology will reduce the costs of performing non-recurring activities, and how that technology may reduce the need for such activities. As the Cost Panel Testimony explains, Verizon VA does not base its non-recurring cost estimates on the network currently in place. Rather, it models those costs based on the network Verizon VA *actually expects* to have in place at the end of the three-year planning period.[12]

In this respect, Verizon VA's non-recurring cost model differs from its model for recurring costs. Recall that Verizon VA's model of recurring costs assumes that the going-forward technology mix has been fully implemented throughout the network: *i.e.*, if the forward-looking engineering guideline is for replacement and new construction of feeder plant such that the network moves toward a mix of 17.7% percent copper and 82.3% fiber, then the whole network is *assumed* to reflect that composition, even though in actuality the fiber proportion is much less. The non-recurring cost model differs in that it does not make the full-deployment assumption, and instead measures costs based on the mix of technologies that will *actually* be in place at the end of the planning period.

[11] *See id.*

[12] *See id.*

Q. Does this mean that the non-recurring cost model does not comport with the forward-looking principles you say are embodied in the recurring cost model?

A. No. As I explained earlier in this testimony and as Dr. Gordon explains in his testimony, an economically correct cost study should be based on the actual mix of technology that will be used over time. The non-recurring cost model thus comports exactly with what sound economic analysis prescribes. The recurring cost model is a simplification that adopts the costs of the forward-looking technology as a proxy value that reflects the reduced capital value of existing plant that does not in actuality get replaced. But it avoids, in the most forward-looking manner possible, the very difficult exercise of directly measuring the reduced capital value of existing plant. That proxy is a lower bound on the costs of existing, useful plant and thus probably understates the true forward-looking costs of the network.

More importantly and fundamentally, the mere existence of new technology that might reduce or eliminate the labor time needed for non-recurring activities (but that was not otherwise efficient to deploy for reasons already discussed) would not affect the costs of performing those activities on existing plant. This is a key distinction from recurring costs, where the *mere existence* of more efficient technology may reduce the economic value of existing facilities and hence reduce the forward-looking costs of those facilities. It does so by reducing the capital costs of the existing facilities (by reducing the opportunity costs of using it rather than selling it) and by reducing the necessary depreciation allowances (because the value of the facilities to be recovered is lower than before the new technology came along). Neither of these effects on the network elements used to provide recurring functions has any impact on non-recurring costs. Reduced capital value does not reduce or eliminate the labor time needed to perform non-recurring activities on existing plant. And so long as it is efficient going forward for the firm to be using that existing plant instead of replacing it, the non-recurring cost estimates should reflect the actual mix of existing facilities expected to be used over the planning period. That is what Verizon VA's non-recurring cost model does.

Any model that did not reflect the real, forward-looking non-recurring costs of the network would promote inefficient use of the incumbent networks by new entrants and inefficient network investment decisions by the incumbents.

D. VERIZON VA'S COST MODEL COMPLIES WITH TELRIC PRINCIPLES.

Q. Is Verizon VA's cost model consistent with TELRIC?

A. Yes. For all the reasons explained above, Verizon VA's cost model is strongly forward-looking. It assumes that the efficient, forward-looking mix of technologies has not only been deployed incrementally over the planning period, but that it has in fact been fully deployed throughout the network. In this regard Verizon VA's model likely understates the costs the company expects to incur in the future. The reason for the likely understatement is that Verizon VA models its costs based on hypothetical, network-wide deployment of best-available technology, but without incorporating the higher cost of capital and depreciation that would be necessary to compensate for the added risk created by such a full replacement of its network.

Q. Does this conclude your testimony?

A. Yes.

Declaration of Howard Shelanski

I declare under penalty of perjury that the foregoing is true and correct. Executed this 25th day of July, 2001.

Howard Shelanski

Howard Shelanski